

Enhancing Safety

Intelligent machines perform in areas inaccessible to workers

- ♦ **Light Duty Utility Arm** deploys measuring instruments and retrieval tools through small openings in radioactive waste tanks
- ♦ **Houdini Remotely Operated Vehicle** fits through narrow tank risers and unfolds into a versatile mini-bulldozer with manipulator arms and cameras
- ♦ **Pipe Explorer** allows visualization and characterization of contaminated ductwork and piping

Protective and monitoring gear ensures safety, comfort and increased productivity

- ♦ **Heat Stress Monitoring System** allows supervisors to continuously track heart rates, skin temperature, and other indicators of individual workers
- ♦ **Personal Ice Cooling System** fits under protective suits to reduce heat stress and allow increased “stay time”

Remotely-operated equipment isolates workers from health hazards

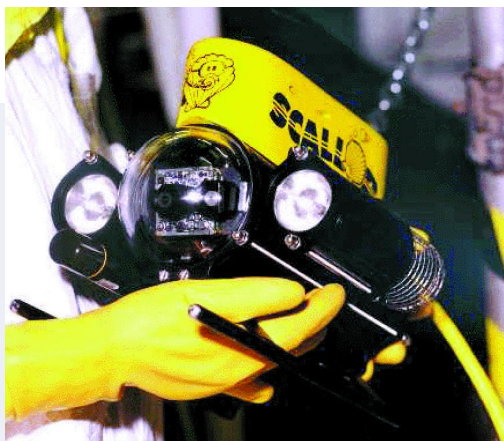
- ♦ **Remote Concrete Demolition System** extends worker's reach into hazardous demolition areas and greatly reduces worker fatigue
- ♦ **Diamond Wire Saw Cutting** segments complex metal structures from the outside, reducing personnel exposure to highly contaminated and radioactive materials
- ♦ **Remote Underwater Characterization System** operates underwater in high radiation areas



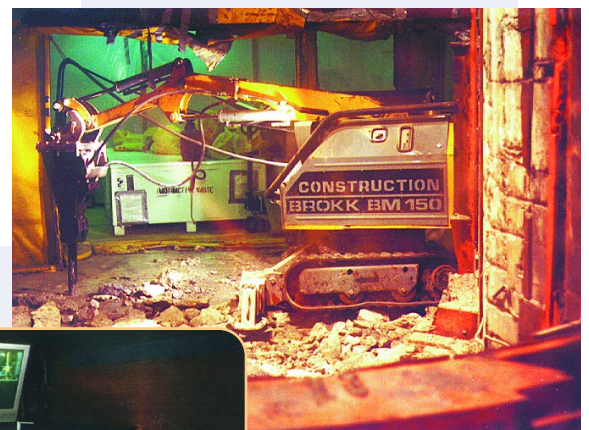
Houdini Remotely Operated Vehicle positions sludge inside waste tanks for pickup up by retrieval tools



Personal Ice Cooling System reduces heat stress and increases worker productivity in hot environments



Remote Underwater Characterization System transports cameras and sensors into spent fuel pools and underwater reactors



With strategically placed cameras, the **Remote Concrete Demolition System** can be operated from outside the work area



Solutions

Light Duty Utility Arm [#85]

A mobile, multi-axis positioning system is the core of a suite of technologies that can access DOE's radioactive waste tanks through existing openings in the tank dome. This flexible and adaptive system provides a robotic platform capable of deploying in situ surveillance, inspection, waste analysis, and light-duty retrieval tools called end effectors. The system is operated remotely, reducing operator exposure. A modified version of the Light Duty Utility Arm was developed to support retrieval activities at Oak Ridge.

Houdini Remotely Operated Vehicle [#2085]

Houdini is a remotely controlled, hydraulically powered, folding vehicle that can pass through a 24-inch-diameter opening and then unfold to a 4- by 5- foot mini-bulldozer, complete with a plow blade, manipulator arm, and remote camera system. It can be used for many decontamination and decommissioning tasks and was one of several technologies supported by OST robotics research and development activities for use in an integrated retrieval system for the cleanup of the gunite tanks at Oak Ridge.

Pipe Explorer [#74]

DOE must characterize radiological contamination inside piping systems before the pipe can be remediated, recycled, or disposed. Physical access constraints and the inability to measure threshold surface contamination values and worker exposure limit the effectiveness of traditional survey approaches. The Pipe Explorer system uses air pressure to insert a tubular plastic membrane through pipes and around elbows, towing a video camera, characterization sensor, or pipe-locating equipment. Because detectors are transported inside the membrane they are protected from contamination, eliminating false readings. The system can be used in pipes as small as 2-inch diameter and up to 250-feet long.

Personal Ice Cooling System [#1898]

A self-contained core body temperature control system enables workers wearing personal protective equipment (PPE) in hot environments to keep cool without inhibiting their work. PICS is an undergarmentlike suit made of a nonflammable material. A three-speed, battery-powered pump circulates ice water from an insulated backpack through tubing sewn into the material. The suit improves worker safety, comfort, mobility, and productivity. It has been deployed at 15 EM sites through support from OST.

Heat Stress Monitoring System [#1953]

This wearable monitor provides a real-time gauge of a worker's physical state while working in a hazardous environment. The system monitors temperature, heart rate, and body activity every 3 seconds. If heat stress or high heart rate is detected, the system automatically activates a light-emitting diode warning device mounted near the worker's eyes and sends an alarm to a supervisory station up to 1,000 feet away. The unit can also accommodate external sensors for radiation, toxic chemicals, or noise.

Remote Underwater Characterization System (RUCS) [#2151]

A small, remotely operated submersible vehicle was used at the Idaho National Engineering and Environmental Laboratory to visually survey the canal connecting two underwater reactors and gather radiological characterization data. Its small size and maneuverability allowed it to closely approach objects and view them from various angles. Another benefit of the technology is that it requires fewer people than the baseline to be suited up in the canal area, saving labor costs and reducing the potential for personnel exposure and contamination.

Diamond Wire Saw Cutting [#2389]

Large radioactive steel structures and highly reinforced concrete walls found in decommissioned research reactors can now be dismantled using diamond wire technology. The saw safely and cost-effectively segments heat exchangers, tanks, and other objects while significantly reducing worker exposure to highly contaminated and radioactive materials. The technology is being used for the Tokamak Fusion Test Reactor (TFTR) in Princeton, New Jersey, and the bioshield and associated structures at Battelle laboratories in Columbus, Ohio.

Remote Concrete Demolition System [#2100]

At the Argonne National Laboratory and the Idaho National Engineering and Environmental Laboratory this system accomplished concrete demolition tasks in days instead of months while minimizing worker exposure to contaminants and industrial hazards. With the **Compact Remote Operator Console [#2180]** and strategically placed cameras, operators no longer have to be in the line-of sight of the demolition. The remote viewing system is now being used at Oak Ridge National Laboratory to control other robots used in cutting and removal of overhead piping.